be incorporated into the electrode itself so that the electrode is a scattering layer. Shapes of refractive elements may be cylindrical, rectangular, or spherical, but it is understood that the shape is not limited thereto. The difference in refractive indices between materials in the scattering layer **22** may be, for example, from 0.3 to 3, and a large difference is generally desired. The thickness of the scattering layer, or size of features in, or on the surface of, a scattering layer may be, for example, 0.03 to 50 μm. It is generally preferred to avoid diffractive effects in the scattering layer. Such effects may be avoided, for example, by locating features randomly or by ensuring that the sizes or distribution of the refractive elements are not the same as the wavelength of the color of light emitted by the device from the light-emitting area.

[**0050**] The scattering layer **22** should be selected to get the light out of the OLED as quickly as possible so as to reduce the opportunities for re-absorption by the various layers of the OLED device. If the scattering layer **22** is to be located between the organic layers **14** and the transparent low-index element **18**, or between the organic layers **14** and a reflective electrode **16**, then the total diffuse transmittance of the same layer coated on a glass support should be high (preferably greater than 80%). In other embodiments, where the scattering layer **22** is itself desired to be reflective, then the total diffuse reflectance of the same layer coated on a glass support should be high (preferably greater than 80%). In all cases, the absorption of the scattering layer should be as low as possible (preferably less than 5%, and ideally 0%).

[**0051**] Materials of the light scattering layer **22** can include organic materials (for example polymers or electrically conductive polymers) or inorganic materials. The organic materials may include, e.g., one or more of polythiophene, PEDOT, PET, or PEN. The inorganic materials may include, e.g., one or more of $SiO_x(x>1)$, $SiN_x(x>1)$, Si_3N_4, TiO_2, MgO, ZnO, Al_2O_3, SnO_2, In_2O_3, MgF_2, and CaF_2. The scattering layer **22** may comprise, for example, silicon oxides and silicon nitrides having a refractive index of 1.6 to 1.8 and doped with titanium dioxide having a refractive index of 2.5 to 3. Polymeric materials having refractive indices in the range of 1.4 to 1.6 may be employed having a dispersion of refractive elements of material with a higher refractive index, for example titanium dioxide.

[**0052**] Conventional lithographic means can be used to create the scattering layer using, for example, photo-resist, mask exposures, and etching as known in the art. Alternatively, coating may be employed in which a liquid, for example polymer having a dispersion of titanium dioxide, may form a scattering layer **22**.

[**0053**] One problem that may be encountered with such scattering layers is that the electrodes may tend to fail open at sharp edges associated with the scattering elements in the layer **22**. Although the scattering layer may be planarized, typically such operations do not form a perfectly smooth, defect-free surface. To reduce the possibility of shorts between the first and second electrodes **12** and **16**, a short-reduction layer **29** may be employed between the electrodes, as illustrated in **FIG. 12**. Such a layer is a thin layer of high-resistance material (for example having a through-thickness resistivity between 10^{-7} ohm-cm^2 to 10^3 ohm-cm^2). Because the short-reduction layer is very thin, device current can pass between the electrodes through the device layers but leakage current through the shorts are much reduced. Such layers are described in co-pending, commonly assigned U.S. Ser. No. 10/822,517, filed Apr. 12, 2004, the disclosure of which is incorporated herein by reference.

[**0054**] Most OLED devices are sensitive to moisture or oxygen, or both, so they are commonly sealed in an inert atmosphere such as nitrogen or argon, along with a desiccant such as alumina, bauxite, calcium sulfate, clays, silica gel, zeolites, alkaline metal oxides, alkaline earth metal oxides, sulfates, or metal halides and perchlorates. Methods for encapsulation and desiccation include, but are not limited to, those described in U.S. Pat. No. 6,226,890 issued May 8, 2001 to Boroson et al. In addition, barrier layers such as $SiO_x(x>1)$, Teflon, and alternating inorganic/polymeric layers are known in the art for encapsulation.

[**0055**] In particular, as illustrated in **FIG. 12**, very thin layers of transparent encapsulating materials **31** may be deposited on the electrode **12**. In this case, the scattering layer **22** may be deposited over the layers of encapsulating materials **31**. This structure has the advantage of protecting the electrode **12** during the deposition of the scattering layer **22**. Preferably, the layers of transparent encapsulating material **31** has a refractive index comparable to the first refractive index range of the transparent electrode and organic layers, or is very thin (e.g., less than about 0.2 micron) so that wave guided light in the transparent electrode and organic layers will pass through the layers of transparent encapsulating material **31** and be scattered by the scattering layer **22**.

[**0056**] OLED devices of this invention can employ various well-known optical effects in order to enhance their properties if desired. This includes optimizing layer thicknesses to yield maximum light transmission, providing dielectric mirror structures, replacing reflective electrodes with light-absorbing electrodes, providing anti-glare or anti-reflection coatings over the display, providing a polarizing medium over the display, or providing colored, neutral density, or color conversion filters over the display. Filters, polarizers, and anti-glare or anti-reflection coatings may be specifically provided over the cover or as part of the cover.

[**0057**] The present invention may also be practiced with either active- or passive-matrix OLED devices. It may also be employed in display devices or in area illumination devices. In a preferred embodiment, the present invention is employed in a flat-panel OLED device composed of small molecule or polymeric OLEDs as disclosed in but not limited to U.S. Pat. No. 4,769,292, issued Sep. 6, 1988 to Tang et al., and U.S. Pat. No. 5,061,569, issued Oct. 29, 1991 to VanSlyke et al. Many combinations and variations of organic light-emitting displays can be used to fabricate such a device, including both active- and passive-matrix OLED displays having either a top- or bottom-emitter architecture.

[**0058**] The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

PARTS LIST

[**0059**] **1**, **2**, **3**, **4**, **5**, **6** light rays

[**0060**] **10** substrate

[**0061**] **12** transparent electrode